WRITTEN REPLY

Refutation

(1) We have reviewed the decision by the International Searching Authority dated November 22, 2004 with regard to the present application. The decision indicates that no novelty or nonobviousness can be found in the scope of patent claims 1 through 4. More specifically, reference literature 1 (Japanese Examined Patent Publication No. 2002-521644) is quoted over the present invention according to claims 1 through 4 and it is determined that the present invention does not achieve any novelty over the invention disclosed in quoted reference 1 related to a heat exchanger comprising a pair of tanks and a plurality of tubes disposed between the pair of tanks and adopting a structure in which the tubes are connected to the tanks with the portions of the tubes on the two sides thereof twisted so as to assure the desired level of pressure withstanding performance and to reduce the inner volumetric capacity. It also determines that the present invention does not achieve any nonobviousness over quoted reference 1 either, since the specific dimensional relationship to be achieved with regard to the diameter of the tanks and the longest path extending from the coolant entrance to the opening at a tube and the specific value to be achieved with regard to the tank sectional area are matters that can be conceived with ease by persons skilled in the art.

The applicant of the present invention does not accept these decisions and would like to refute the decisions by clarifying the differences between the present invention and the quoted reference.

(2) In the scope of patent claims,

" A heat exchanger comprising:

a pair of tanks;

a plurality of tubes disposed between said pair of tanks; and

fins disposed between said tubes, with said pair of tanks made to communicate with each other via said tubes having open ends on the two sides thereof along the length of said tubes inserted at insertion holes formed at said tanks and the width of a specific area of said tubes along the axes of said tanks set greater than an equivalent diameter of said tanks corresponding to said tank passage section, characterized in:

that $15 \leq L/Dt \leq 42$ is true with Dt representing the equivalent diameter corresponding to said tank passage section and L representing the length of a longest path ranging from a coolant entrance to the open end of said tubes. (claims 1)"

"A heat exchanger according to claim 1, characterized in:

that with S representing the flow passage area inside said tanks, $20\ mm^2 \leq S \leq 50\ mm^2$ is true. (claim 2)"

"A heat exchanger according to claim 1 or claim 2, characterized in:

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that with S representing the flow passage area inside said tanks, P representing the length of the inner circumference of said tanks and Sc representing the area of a circle with the circumference P, $S \geq Sc \times 0.7$ is true. (claim 3)"

"A heat exchanger according to any of claims 1, 2 or 3, characterized in:

that said tubes adopt a twisted structure so that the width along the axes of said tanks is greater than the width along the direction of airflow over central areas of said tubes along the length thereof and the width along the direction of airflow is greater than the width along the tank axes at tube openings on the two sides thereof. (claim 4)" are disclosed.

The invention disclosed in claim 1 provides a specific relationship to be achieved by numerical values so as to assure superior coolant distributability as well as a reduction in the external dimensions of the tanks and a reduction in the weight of the tanks in a heat exchanger equipped with the tanks the inner diameter of which is set smaller relative to the tube width.

By adopting the invention disclosed in claims 2 and 3, in particular, tanks with a flow passage area assuring a desired level of resistance to pressure damage and a desired level of pressure withstanding performance are provided.

The invention disclosed in claim 4 allows the openings at the tube insertion holes formed at the tanks to assume a shape whereby the width along the axial direction is greater than the width along the radius of the tanks. Thus, the width of the tubes over the central area thereof, along the tank axes can be set greater than the inner width along the tank radius. Namely, even as the inner widths of the inflow chamber and the outflow chamber of the tanks are reduced to allow the tanks to assume a relatively large wall thickness at the side surfaces thereof without increasing the external dimensions in order to accommodate the use of a high-pressure coolant such as a CO2 coolant and the tank dimensions are set accordingly, the width of the tubes over the central areas thereof along the tank axes remains unaffected. As a result, the tubes are allowed to retain dimensions that will minimize the passage resistance (pressure damage rate) when the coolant passes through the coolant passage.

(3) Quoted reference 1 (Japanese Examined Patent Publication No. 2002-521644) discloses a heat exchanger comprising a pair of tanks and a plurality of tubes disposed between the pair of tanks, with the tubes connected to the tanks at connecting portions on the two sides thereof which are twisted so as to assure the desired level of pressure withstanding performance and achieve a relative reduction in the inner volumetric capacity. Quoted reference 1 specifically mentions that the structure is particularly ideal in applications in evaporators used in automotive air-conditioning systems in which a CO2 coolant is used (see paragraph [0032]). However, paragraph [0018] in quoted reference 1 simply describes that in a heat exchanger that includes tubes with twisted ends, in which the tube width (the width

of the tubes along the axes of the tanks) is set greater than the equivalent diameter of the passage section at the tanks, the longitudinal holes formed at the collector tubes extend parallel to the central line extending along the length of the collector tubes (equivalent to the tanks according to the present invention). This allows the inner diameter of the collector tubes to be reduced. It further describes that the minimum requirement with regard to the inner diameter is that it be only slightly greater than the thickness of the flat tubes. However, it does not disclose any specific relationship to be achieved by the inner diameter of the collector tubes (the equivalent diameter at the passage section) and the length of the longest path extending to the tube open end or does not indicate any specific coolant distribution characteristics to be achieved.

While the examiner asserts that the dimensional relationship to be achieved with regard to the tank diameter and the length of the longest path extending from the coolant entrance to the open end of a tube and the specific value representing the size of the tank section area are matters that can be conceived with ease by persons skilled in the art, a sufficient level of pressure withstanding performance and a small enough inner volumetric capacity can be achieved simply by ensuring that the inner diameter of the tanks is slightly larger than the thickness of the flat tubes. However, such simple reasoning is likely to lead to excessive reductions in the diameter and the weight of the tanks to result in poor coolant distributability and ultimately poor heat exchanging efficiency.

Namely, if the diameter and the weight of the tanks are to be simply reduced without taking into consideration other factors, the ratio (L/Dt) of the length L of the longest path from the coolant entrance to the open end of a tube to the equivalent diameter Dt at the tank passage section may become greater than 42 with an extremely small value selected for Dt. In other words, it would appear that the greater the ratio (L/Dt) (greater than 42), the better from this perspective. However, this logic is faulty in that it does not take into consideration another crucial matter, i.e., the coolant distribution. In other words, the distribution of the coolant to the tubes disposed over greater distances from the coolant entrance is bound to be compromised in this structure. This means that in order to assure desirable coolant distribution characteristics while achieving reductions in the external dimensions and the weight of the tanks in a heat exchanger that includes tubes, the width of which (the tube width along the tank axes) is set greater than the equivalent diameter at the tank passage section, further structural contrivances must be conceived. In other words, the concept disclosed in the present invention cannot be easily conceived by persons skilled in the art by solely focusing on the reductions in the diameter and weight of the tanks.

Quoted reference 1 does not imply or indicate either implicitly or explicitly a structure equivalent to that disclosed in the present invention conceived to achieve the object of achieving miniaturization and weight reduction for the tanks while

improving the coolant distribution characteristics and, for this reason, we are convinced that even persons skilled in the art would not be able to conceive the invention disclosed in the scope of patent claims based upon the teachings of quoted reference 1.

(4) As detailed above, the invention according to claim 1 and the invention disclosed in claims dependent to claim 1 represent a technical concept whereby miniaturization and weight reduction are achieved for the tanks while improving the coolant distribution characteristics, which is clearly different from the technical concept of quoted reference 1, and we believe that even persons skilled in the art would not be able to easily conceive an art equivalent to that of the present invention.

As detailed above, we believe that the invention according to claims 1 through 4 does achieve novelty and nonobviousness and we request that the invention be re-examined accordingly.